Notice of Allowability	Application No.	Applicant(s)	
	10/675,314	SKIBINSKI, GARY LEONARD	
	Examiner	Art Unit	
	Anh T. Mai	2832	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *amendment filed March 20, 2006*.

2. ☒ The allowed claim(s) is/are *1-4 and 6-21*.

3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☐ All b) ☐ Some* c) ☐ None of the:
      1. ☐ Certified copies of the priority documents have been received.
      2. ☐ Certified copies of the priority documents have been received in Application No. _____.
      3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
      1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO-1449 or PTO/SB/08), Paper No./Mail Date _____
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____.
7. ☐ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☒ Other *Koike's translation*. 47 pgs

REASONS FOR ALLOWANCE

1. Claims 1-4, 6-21 are allowed.

2. The following is an examiner's statement of reasons for allowance:

Claim 1 recites, inter alia, *plurality of leads electrically coupled to the inductor coil and accessible from the modular enclosure wherein the modular enclosure is configured for mounting adjacent to similar modular inductors in a multi-phase inductor assembly.*

Claim 13 recites, inter alia, *a current sensor disposed within the enclosure and configured to sense current through at least one of the inductors.*

Claim 17 recites, inter alia, *a current sensor disposed within the enclosure and configured to sense current through the inductor coil.*

Claim 21 recites, inter alia, *power converter circuit and the inductor assembly being mounted on a fluid cooled support for extraction of heat from the inductor assembly via the mounting surface.*

The references of record do not teach or suggest the aforementioned limitation, nor would it be obvious to modify those references to include such limitation.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Anh T. Mai whose telephone number is 571-272-1995. The examiner can normally be reached on 5/4/9 Schedule.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Elvin Enad can be reached on 571-272-1990. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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ANH MAI
PRIMARY EXAMINER

PTO 06-1503

Japanese Patent
Document No. H11-195533

SMD-TYPE COIL AND METHOD FOR MANUFACTURING THE SAME

[SMD Gata Koiru Oyobi Sono Seizo Hoho]

Akira Koike

UNITED STATES PATENT AND TRADEMARK OFFICE
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English Title	:	SMD-TYPE COIL AND METHOD FOR MANUFACTURING THE SAME

/1[1]

(54) Title of the invention

SMD-type coil and method for manufacturing the same

(57) Summary

Problems: Action errors of peripheral electronic appliances due to electromagnetic noises generated from a coil are feared in a case where said coil is characterized by an open loop constitution.

Solution mechanism: The insulation substrate (21), which is constituted by a glass-epoxy resin, etc. and which possesses the open unit (21a) for storing a cylindrical coil, an electrode pattern formed on said insulation substrate (21) for surface outfitting purposes, the adhesive sheet (23) pasted onto the lower plane of said insulation substrate (21), and the closed magnetic path-type cylindrical coil (5) constituted not only to become stored within the open unit (21a) but also to possess the terminals (3b) & (3c) to be connected to an electrode pattern [sic: No predicate] ..., the terminals (3b) & (3c) are connected to the electrode pattern formed above the insulation substrate (21) by means of soldering via the solder (16) or a fixation mechanism (e.g., hot press, etc.) and sealed with the sealing resin (17). A closed magnetic path constitution is provided by the cylindrical bobbin (4), and in such a case, no noises are generated by virtue of the closed loop constitution of the coil. Large numbers of SMD-type coils with high reliabilities can be mass-produced, and an inexpensive, compact, & thin constitution can be realized.

Patent Claims /2

Claim 1

An SMD-type coil characterized by the fact that [it is constituted by?] an insulation substrate which is constituted by a glass-epoxy resin, etc. and which possesses an open unit for storing a

[1] Numbers in the margin indicate pagination in the foreign text.

cylindrical coil, an electrode pattern formed on said insulation substrate for surface outfitting purposes, and a closed magnetic path-type cylindrical coil constituted not only to become stored within the aforementioned open unit but also to possess terminals to be connected to the aforementioned electrode pattern, that the aforementioned closed magnetic path-type cylindrical coil is positioned on & fixed to the open unit of the aforementioned insulation substrate, and that the terminals of the closed magnetic path-type cylindrical coil are connected to the electrode pattern formed above the insulation substrate and sealed with a sealing resin.

Claim 2

An SMD-type coil characterized by the fact that [it is constituted by?] an insulation substrate which is constituted by a glass-epoxy resin, etc. and which possesses an open unit for storing a cylindrical coil, an electrode pattern formed on said insulation substrate for surface outfitting purposes, an adhesive sheet pasted onto the lower plane of the aforementioned insulation substrate, and a closed magnetic path-type cylindrical coil constituted not only to become stored within the aforementioned open unit but also to possess terminals to be connected to the aforementioned electrode pattern, that the aforementioned closed magnetic path-type cylindrical coil is positioned on & fixed to the aforementioned adhesive sheet, and that the terminals of the closed magnetic path-type cylindrical coil are connected to the electrode pattern formed above the insulation substrate and sealed with a sealing resin.

Claim 3

An SMD-type coil characterized by the fact that [it possesses?] an upper plane electrode pattern, a first minor insulation substrate with a virtually rectangular shape on which is formed a through-hole electrode connected to said upper plane electrode pattern, and a second minor insulation substrate the shape of which is virtually identical to that of said first minor insulation substrate, that the aforementioned pair of minor insulation substrates are configured in opposition to one another via a certain gap above an adhesive sheet in a state where both through-hole electrodes are being positioned on the respective outsides for forming an open unit for storing the cylindrical

bobbin of a closed magnetic path-type cylindrical coil, that the cylindrical bobbin of the closed magnetic path-type cylindrical coil is positioned on & fixed to the adhesive sheet of the aforementioned open unit, and that the terminals of the closed magnetic path-type cylindrical coil are connected to the upper plane electrode pattern formed on the aforementioned first minor insulation substrate and sealed with a sealing resin.

Claim 4

An SMD-type coil specified in Claim 2 or 3 characterized by the fact that a sheet-shaped component is, after the filling of the aforementioned sealing resin, mounted on the upper plane of the cylindrical bobbin of the aforementioned closed magnetic path-type cylindrical coil for curing said resin.

Claim 5

An SMD-type coil specified in Claim 4 characterized by the fact that a sheet-shaped component is, after the filling of the aforementioned sealing resin, mounted on the upper plane of the cylindrical bobbin of the aforementioned closed magnetic path-type cylindrical coil for curing said resin and that the adhesive sheet fixing the aforementioned insulation substrate and the cylindrical bobbin of the closed magnetic path-type cylindrical coil is subsequently peeled.

Claim 6

An SMD-type coil specified in Claim 2 or 3 characterized by the fact that the adhesive sheet fixing the aforementioned insulation substrate and the cylindrical bobbin of the closed magnetic path-type cylindrical coil is peeled after the filling and then curing of the aforementioned sealing resin.

Claim 7

An SMD-type coil specified in any of Claims 1 ~ 6 characterized by the fact that the quantitative ratio of the aforementioned sealing resin is selected in such a way that a portion of the cylindrical bobbin of the closed magnetic path-type cylindrical coil will be even with or slightly protrude from the resin plane.

Claim 8

A method for manufacturing an SMD-type coil characterized by the fact that it consists of an aggregate insulation substrate work process whereby multiple columns of open units for storing the respective cylindrical bobbins of multiple closed magnetic path-type cylindrical coils are formed on the flat plane of an aggregate insulation substrate made of a glass-epoxy resin, etc. & scheduled to be individualized into multiple units and whereby multiple through-holes for connecting an upper plane electrode pattern are formed in-between adjacent members of the aforementioned columns, a plating process whereby a plating layer is formed, by means of a plating work, on the entire surface of the aggregate insulation substrate inclusive of the inner planes of the aforementioned through-holes, an electrode pattern formation process whereby not only an upper plane electrode pattern for the aforementioned aggregate insulation substrate but also through-hole electrodes for the aforementioned through-holes are formed by adding a plating resist and by exposing, via a pattern mask, & developing the same for etching patterns, an adhesive sheet pasting process whereby an adhesive sheet on which are formed punch-through holes at positions corresponding to the respective through-holes formed on the aforementioned aggregate insulation substrate is pasted onto the rear plane side of the aforementioned aggregate insulation substrate in a state where the positions of the punch-through holes thereof are being matched with the aforementioned through-holes, a closed magnetic path-type cylindrical coil feeding process whereby closed magnetic path-type cylindrical coils are concurrently fed into and positioned within the open units formed on the aforementioned aggregate insulation substrate and whereby the cylindrical bobbins of the former are pasted onto the adhesive sheet plane, an outfitting process whereby the terminals of the aforementioned closed magnetic path-type cylindrical coils are connected, via a fixation mechanism such as soldering, hot press, etc., to the upper plane electrode pattern of the aforementioned aggregate insulation substrate, a resin feeding process whereby a resin-molding mold frame is configured around the aforementioned aggregate insulation substrate and whereby a sealing resin such as an epoxy resin, etc. is filled into the resulting gap, a resin sealing process whereby a sheet-

shaped component is contacted with & mounted on the upper plane of the cylindrical bobbins of the aforementioned closed magnetic path-type cylindrical coils within the aforementioned resin-molding mold frame for curing the filled sealing resin, a peeling process whereby the sheet-shaped component is, after the curing of the sealing resin, peeled without peeling the adhesive sheet on the lower plane side of the aforementioned aggregate insulation substrate, and a cutting process whereby the aggregate insulation substrate is divided into individual SMD-type coils by cutting, by using a dicing machine or slicing machine, the former not only along a cutting line passing through the virtual centers of the through-holes thereof but also along a cutting line perpendicular to the former cutting line in a state where a single closed magnetic path-type cylindrical coil is being enclosed in-between adjacent lines.

Claim 9

A method for manufacturing an SMD-type coil specified in Claim 8 characterized by the fact that it includes, after the aforementioned resin sealing process, a cutting process whereby the aggregate insulation substrate is divided into individual SMD-type coils by cutting, by using a dicing machine or slicing machine, the former not only along a cutting line passing through the virtual centers of the through-holes thereof but also along a cutting line perpendicular to the former cutting line in a state where a single closed magnetic path-type cylindrical coil is being enclosed in-between adjacent lines in a state where both the aforementioned sheet-shaped component and adhesive sheet on the lower plane side of the aggregate insulation substrate remain unremoved.

Claim 10

A method for manufacturing an SMD-type coil specified in Claim 8 characterized by the fact that it includes, after the aforementioned resin sealing process, a peeling process whereby the sheet-shaped component is peeled without peeling the aforementioned sheet-shaped component and a cutting process whereby the aggregate insulation substrate is divided into individual SMD-type coils by cutting, by using a dicing machine or slicing machine, the former not only along a cutting line passing through the virtual centers of the through-holes thereof but also along a cutting line

perpendicular to the former cutting line in a state where a single closed magnetic path-type cylindrical coil is being enclosed in-between adjacent lines.

Claim 11

A method for manufacturing an SMD-type coil specified in Claim 8 characterized by the fact that it includes, after the aforementioned resin sealing process, a peeling process whereby both the aforementioned sheet-shaped component and adhesive sheet on the lower plane side of the /3 aggregate insulation substrate are peeled and a cutting process whereby the aggregate insulation substrate is divided into individual SMD-type coils by cutting, by using a dicing machine or slicing machine, the former not only along a cutting line passing through the virtual centers of the through-holes thereof but also along a cutting line perpendicular to the former cutting line in a state where a single closed magnetic path-type cylindrical coil is being enclosed in-between adjacent lines.

Claim 12

A method for manufacturing an SMD-type coil characterized by the fact that it consists of an aggregate insulation substrate work process whereby not only open units for storing the respective cylindrical bobbins of multiple closed magnetic path-type cylindrical coils but also multiple through-holes for connecting an upper plane electrode pattern are formed on the flat plane of the aforementioned aggregate insulation substrate [sic: No reference to any previous claim], an electrode pattern formation process whereby an upper plane electrode pattern for the aforementioned aggregate insulation substrate and through-hole electrodes are formed, an adhesive sheet pasting process whereby an adhesive sheet the size of which is virtually equal to that of the aforementioned aggregate insulation substrate but which possesses no punch-through holes corresponding to the aforementioned through-holes is pasted onto the rear plane side of the aforementioned aggregate insulation substrate, a closed magnetic path-type cylindrical coil feeding process whereby closed magnetic path-type cylindrical coils are concurrently fed into and positioned within the open units formed on the aforementioned aggregate insulation substrate and whereby the cylindrical bobbins of the former are pasted onto the adhesive sheet plane, an outfitting

process whereby the terminals of the aforementioned closed magnetic path-type cylindrical coils are connected, via a fixation mechanism such as soldering, hot press, etc., to the upper plane electrode pattern of the aggregate insulation substrate, a resin feeding process whereby a resin-molding mold frame is configured around the aforementioned aggregate insulation substrate and whereby a sealing resin such as an epoxy resin, etc. is filled into & cured within the resulting gap, a peeling process whereby the adhesive sheet on the lower plane side of the aforementioned aggregate insulation substrate is peeled after the curing of the sealing resin, and a cutting process whereby the aggregate insulation substrate is divided into individual SMD-type coils by cutting, by using a dicing machine or slicing machine, the former not only along a cutting line passing through the virtual centers of the through-holes thereof but also along a cutting line perpendicular to the former cutting line in a state where a single closed magnetic path-type cylindrical coil is being enclosed in-between adjacent lines.

Claim 13

A method for manufacturing an SMD-type coil characterized by the fact that it consists of an aggregate insulation substrate work process whereby not only open units for storing the respective cylindrical bobbins of multiple closed magnetic path-type cylindrical coils but also multiple through-holes for connecting an upper plane electrode pattern are formed on the flat plane of the aforementioned aggregate insulation substrate [sic: No reference to any previous claim], an electrode pattern formation process whereby an upper plane electrode pattern for the aforementioned aggregate insulation substrate and through-hole electrodes are formed, an adhesive sheet pasting process whereby an adhesive sheet on which are formed punch-through holes at positions corresponding to the respective through-holes formed on the aforementioned aggregate insulation substrate is pasted onto the rear plane side of the aforementioned aggregate insulation substrate in a state where the positions of the punch-through holes thereof are being matched with the aforementioned through-holes, a closed magnetic path-type cylindrical coil feeding process whereby closed magnetic path-type cylindrical coils are concurrently fed into and positioned within

the open units formed on the aforementioned aggregate insulation substrate and whereby the cylindrical bobbins of the former are pasted onto the adhesive sheet plane, an outfitting process whereby the terminals of the aforementioned closed magnetic path-type cylindrical coils are connected, via a fixation mechanism such as soldering, hot press, etc., to the upper plane electrode pattern of the aggregate insulation substrate, a resin feeding process whereby a resin-molding mold frame is configured around the aforementioned aggregate insulation substrate and whereby a sealing resin such as an epoxy resin, etc. is filled into & cured within the resulting gap, and a cutting process whereby the aggregate insulation substrate is divided into individual SMD-type coils by cutting, by using a dicing machine or slicing machine, the former not only along a cutting line passing through the virtual centers of the through-holes thereof but also along a cutting line perpendicular to the former cutting line in a state where a single closed magnetic path-type cylindrical coil is being enclosed in-between adjacent lines without removing the adhesive sheet on the lower plane side thereof.

Claim 14

A method for manufacturing an SMD-type coil characterized by the fact that it consists of an aggregate insulation substrate work process whereby not only open units for storing the respective cylindrical bobbins of multiple closed magnetic path-type cylindrical coils but also multiple through-holes for connecting an upper plane electrode pattern are formed on the flat plane of the aforementioned aggregate insulation substrate [sic: No reference to any previous claim], an electrode pattern formation process whereby an upper plane electrode pattern for the aforementioned aggregate insulation substrate and through-hole electrodes are formed, an adhesive sheet pasting process whereby an adhesive sheet the size of which is virtually equal to that of the aforementioned aggregate insulation substrate but which possesses no punch-through holes corresponding to the aforementioned through-holes is pasted onto the rear plane side of the aforementioned aggregate insulation substrate, a closed magnetic path-type cylindrical coil feeding process whereby closed magnetic path-type cylindrical coils are concurrently fed into and

positioned within the open units formed on the aforementioned aggregate insulation substrate and whereby the cylindrical bobbins of the former are pasted onto the adhesive sheet plane, an outfitting process whereby the terminals of the aforementioned closed magnetic path-type cylindrical coils are connected, via a fixation mechanism such as soldering, hot press, etc., to the upper plane electrode pattern of the aggregate insulation substrate, a resin feeding process whereby a resin-molding mold frame is configured around the aforementioned aggregate insulation substrate and whereby a sealing resin such as an epoxy resin, etc. is filled into the resulting gap, a resin curing process whereby a sheet-shaped component is contacted with & mounted on the upper plane of the cylindrical bobbins of the aforementioned closed magnetic path-type cylindrical coils within the aforementioned resin-molding mold frame for curing the filled sealing resin, a peeling process whereby the adhesive sheet on the lower plane side of the aforementioned aggregate insulation substrate is, after the curing of the sealing resin, peeled without peeling the adhesive sheet on the lower plane side of the aggregate insulation substrate, and a cutting process whereby the aggregate insulation substrate is divided into individual SMD-type coils by cutting, by using a dicing machine or slicing machine, the former not only along a cutting line passing through the virtual centers of the through-holes thereof but also along a cutting line perpendicular to the former cutting line in a state where a single closed magnetic path-type cylindrical coil is being enclosed in-between adjacent lines.

Claim 15

A method for manufacturing an SMD-type coil specified in Claim 14 characterized by the fact that it includes, after the aforementioned resin sealing process, a peeling process whereby both the aforementioned sheet-shaped component and adhesive sheet on the lower plane side of the aggregate insulation substrate are peeled and a cutting process whereby the aggregate insulation substrate is divided into individual SMD-type coils by cutting, by using a dicing machine or slicing machine, the former not only along a cutting line passing through the virtual centers of the through-holes thereof but also along a cutting line perpendicular to the former cutting line in a state where a single closed magnetic path-type cylindrical coil is being enclosed in-between adjacent lines.

Detailed explanation of the invention

[0001]

(Technical fields to which the invention belongs)

The present invention concerns an SMD-type coil used for general electronic appliances such as portable phones, PHS, communications machines, etc. as well as a method for manufacturing the same.

[0002]

(Prior art)

Attempts have been made in recent years not only to upgrade the performances of and diversify the functions of electronic appliances but also to reduce their sizes & weights. Portable phones, PHS, communications machines, etc., for example, instantiate these trends. It has become required to reduce the sizes & thicknesses of closed magnetic path-type cylindrical coils used for these electronic appliances as well, and accordingly, surface-mountable devices (SMDs) have become indispensable.

[0003]

An inductor is an impedance element designed to take advantage of electromagnetism /4 generated in a case where an electric current is permeated through a conductive wire coiled around a core made of a magnetic material (e.g., ferrite, Permalloy, etc.). An SMD-type chip coil is disclosed in Japanese Patent Application Tokugan No. Hei 9[1997]-49586 (application date: February 19, Hei 9[1997]), which the present patent applicant filed earlier. In the following, its outline will be explained with reference to a figure.

[0004]

Figure 18 is an oblique view diagram of the chip coil. In the figure, (10) is a chip coil. The chip coil (10) is constituted by the inductance element (11) & circuit substrate (12), whereas the inductance element (11) is constituted not only by the coil unit (3a) provided by winding the coil (3) around the bar-shaped core (2) made of a magnetic material (e.g., ferrite, Permalloy, etc.) over a certain number of turns but also by the coil initial terminal unit (3b) & coil final terminal unit (3c) formed by terminating, via a solder, the initial & final terminals of said coil unit (3a). The aforementioned circuit substrate (12) is provided by forming, on the upper & lower planes of an insulation substrate made of a glass-epoxy resin, etc., mutually opposing pairs of upper plane electrodes (13a) & (13b) and lower plane electrodes {(14a) & (14b)}, whereas both electrode pairs are constituted to become mutually connected via the semicircular vertical patterns (15a) {& (15b)} formed by cutting inter-column through-holes (14) along a cutting line. The aforementioned chip coil (10) is constituted by connecting, to one electrode formed above the aforementioned circuit substrate (12), namely upper plane electrode pattern (13a), the coil initial terminal unit (3b) of the aforementioned inductance element (11), by connecting, to the other, namely electrode (13b), the coil final terminal unit (3c) of the same via a fixation mechanism {e.g., solder (16), etc.}, and by subsequently coating the entire surface of the aforementioned inductance element (11) with the thermocurable sealing resin (17).

[0005]

(Problems to be solved by the invention)

The above-mentioned chip coil structure, however, is plagued with the following problem. In other words, the aforementioned chip coil is characterized by an open loop constitution without any shield measures, and therefore, action errors of peripheral electronic appliances due to electromagnetic noises generated from said coil are feared.

[0006]

The objectives of the present invention, which has been conceived in acknowledgment of the aforementioned problem of the prior art, are to provide a compact, extremely thin, & inexpensive SMD-type coil with a closed magnetic path constitution obtained by mounting closed magnetic path-type cylindrical coils on an aggregate insulation substrate in a submerged state within the coil storage unit formed on the latter, by sealing the obtained structure with a resin, and by dividing the same into large numbers of individualized SMD-type coils which generate no noises as well as a method for manufacturing the same.

[0007]

(Mechanism for solving the problems)

In order to achieve the aforementioned objectives, the SMD-type coil of the present invention is structurally characterized by the fact that [it is constituted by?] an insulation substrate which is constituted by a glass-epoxy resin, etc. and which possesses an open unit for storing a cylindrical coil, an electrode pattern formed on said insulation substrate for surface outfitting purposes, and a closed magnetic path-type cylindrical coil constituted not only to become stored within the aforementioned open unit but also to possess terminals to be connected to the aforementioned electrode pattern, that the aforementioned closed magnetic path-type cylindrical coil is positioned on & fixed to the open unit of the aforementioned insulation substrate, and that the terminals of the closed magnetic path-type cylindrical coil are connected to the electrode pattern formed above the insulation substrate and sealed with a sealing resin.

[0009]

Another constitution of said coil is characterized by the fact that [it is constituted by?] an insulation substrate which is constituted by a glass-epoxy resin, etc. and which possesses an open unit for storing a cylindrical coil, an electrode pattern formed on said insulation substrate for surface outfitting purposes, an adhesive sheet pasted onto the lower plane of the aforementioned insulation substrate, and a closed magnetic path-type cylindrical coil constituted not only to become stored

within the aforementioned open unit but also to possess terminals to be connected to the aforementioned electrode pattern, that the aforementioned closed magnetic path-type cylindrical coil is positioned on & fixed to the aforementioned adhesive sheet, and that the terminals of the closed magnetic path-type cylindrical coil are connected to the electrode pattern formed above the insulation substrate and sealed with a sealing resin.

[0009]

Still another constitution of said coil is characterized by the fact that [it possesses?] an upper plane electrode pattern, a first minor insulation substrate with a virtually rectangular shape on which is formed a through-hole electrode connected to said upper plane electrode pattern, and a second minor insulation substrate the shape of which is virtually identical to that of said first minor insulation substrate, that the aforementioned pair of minor insulation substrates are configured in opposition to one another via a certain gap above an adhesive sheet in a state where both through-hole electrodes are being positioned on the respective outsides for forming an open unit for storing the cylindrical bobbin of a closed magnetic path-type cylindrical coil, that the cylindrical bobbin of the closed magnetic path-type cylindrical coil is positioned on & fixed to the adhesive sheet of the aforementioned open unit, and that the terminals of the closed magnetic path-type cylindrical coil are connected to the upper plane electrode pattern formed on the aforementioned first minor insulation substrate and sealed with a sealing resin.

[0010]

Still another constitution of said coil is characterized by the fact that a sheet-shaped component is, after the filling of the aforementioned sealing resin, mounted on the upper plane of the cylindrical bobbin of the aforementioned closed magnetic path-type cylindrical coil for curing said resin.

[0011]

Still another constitution of said coil is characterized by the fact that a sheet-shaped component is, after the filling of the aforementioned sealing resin, mounted on the upper plane of

the cylindrical bobbin of the aforementioned closed magnetic path-type cylindrical coil for curing said resin and that the adhesive sheet fixing the aforementioned insulation substrate and the cylindrical bobbin of the closed magnetic path-type cylindrical coil is subsequently peeled.

[0012]

Still another constitution of said coil is characterized by the fact that the adhesive sheet fixing the aforementioned insulation substrate and the cylindrical bobbin of the closed magnetic path-type cylindrical coil is peeled after the filling and then curing of the aforementioned sealing resin.

[0013]

Still another constitution of said coil is characterized by the fact that the quantitative ratio of the aforementioned sealing resin is selected in such a way that a portion of the cylindrical bobbin of the closed magnetic path-type cylindrical coil will be even with or slightly protrude from the resin plane.

[0014]

The method of the present invention for manufacturing an SMD-type coil, furthermore, is characterized by the fact that it consists of an aggregate insulation substrate work process whereby multiple columns of open units for storing the respective cylindrical bobbins of multiple closed magnetic path-type cylindrical coils are formed on the flat plane of an aggregate insulation substrate made of a glass-epoxy resin, etc. & scheduled to be individualized into multiple units and whereby multiple through-holes for connecting an upper plane electrode pattern are formed in-between adjacent members of the aforementioned columns, a plating process whereby a plating layer is formed, by means of a plating work, on the entire surface of the aggregate insulation substrate inclusive of the inner planes of the aforementioned through-holes, an electrode pattern formation process whereby not only an upper plane electrode pattern for the aforementioned aggregate insulation substrate but also through-hole electrodes for the aforementioned through-holes are formed by adding a plating resist and by exposing, via a pattern mask, & developing the same for

etching patterns, an adhesive sheet pasting process whereby an adhesive sheet on which are formed punch-through holes at positions corresponding to the respective through-holes formed on the /5 aforementioned aggregate insulation substrate is pasted onto the rear plane side of the aforementioned aggregate insulation substrate in a state where the positions of the punch-through holes thereof are being matched with the aforementioned through-holes, a closed magnetic path-type cylindrical coil feeding process whereby closed magnetic path-type cylindrical coils are concurrently fed into and positioned within the open units formed on the aforementioned aggregate insulation substrate and whereby the cylindrical bobbins of the former are pasted onto the adhesive sheet plane, an outfitting process whereby the terminals of the aforementioned closed magnetic path-type cylindrical coils are connected, via a fixation mechanism such as soldering, hot press, etc., to the upper plane electrode pattern of the aforementioned aggregate insulation substrate, a resin feeding process whereby a resin-molding mold frame is configured around the aforementioned aggregate insulation substrate and whereby a sealing resin such as an epoxy resin, etc. is filled into the resulting gap, a resin sealing process whereby a sheet-shaped component is contacted with & mounted on the upper plane of the cylindrical bobbins of the aforementioned closed magnetic path-type cylindrical coils within the aforementioned resin-molding mold frame for curing the filled sealing resin, a peeling process whereby the sheet-shaped component is, after the curing of the sealing resin, peeled without peeling the adhesive sheet on the lower plane side of the aforementioned aggregate insulation substrate, and a cutting process whereby the aggregate insulation substrate is divided into individual SMD-type coils by cutting, by using a dicing machine or slicing machine, the former not only along a cutting line passing through the virtual centers of the through-holes thereof but also along a cutting line perpendicular to the former cutting line in a state where a single closed magnetic path-type cylindrical coil is being enclosed in-between adjacent lines.

[0015]

Another constitution of said method is characterized by the fact that it includes, after the aforementioned resin sealing process, a cutting process whereby the aggregate insulation substrate is divided into individual SMD-type coils by cutting, by using a dicing machine or slicing machine, the former not only along a cutting line passing through the virtual centers of the through-holes thereof but also along a cutting line perpendicular to the former cutting line in a state where a single closed magnetic path-type cylindrical coil is being enclosed in-between adjacent lines in a state where both the aforementioned sheet-shaped component and adhesive sheet on the lower plane side of the aggregate insulation substrate remain unremoved.

[0016]

Still another constitution of said method is characterized by the fact that it includes, after the aforementioned resin sealing process, a peeling process whereby the sheet-shaped component is peeled without peeling the aforementioned sheet-shaped component and a cutting process whereby the aggregate insulation substrate is divided into individual SMD-type coils by cutting, by using a dicing machine or slicing machine, the former not only along a cutting line passing through the virtual centers of the through-holes thereof but also along a cutting line perpendicular to the former cutting line in a state where a single closed magnetic path-type cylindrical coil is being enclosed in-between adjacent lines.

[0017]

Still another constitution of said method is characterized by the fact that it includes, after the aforementioned resin sealing process, a peeling process whereby both the aforementioned sheet-shaped component and adhesive sheet on the lower plane side of the aggregate insulation substrate are peeled and a cutting process whereby the aggregate insulation substrate is divided into individual SMD-type coils by cutting, by using a dicing machine or slicing machine, the former not only along a cutting line passing through the virtual centers of the through-holes thereof but also along a cutting line perpendicular to the former cutting line in a state where a single closed magnetic path-type cylindrical coil is being enclosed in-between adjacent lines.

[0018]

Still another constitution of said coil is characterized by the fact that it consists of an aggregate insulation substrate work process whereby not only open units for storing the respective cylindrical bobbins of multiple closed magnetic path-type cylindrical coils but also multiple through-holes for connecting an upper plane electrode pattern are formed on the flat plane of the aforementioned aggregate insulation substrate, an electrode pattern formation process whereby an upper plane electrode pattern for the aforementioned aggregate insulation substrate and through-hole electrodes are formed, an adhesive sheet pasting process whereby an adhesive sheet the size of which is virtually equal to that of the aforementioned aggregate insulation substrate but which possesses no punch-through holes corresponding to the aforementioned through-holes is pasted onto the rear plane side of the aforementioned aggregate insulation substrate, a closed magnetic path-type cylindrical coil feeding process whereby closed magnetic path-type cylindrical coils are concurrently fed into and positioned within the open units formed on the aforementioned aggregate insulation substrate and whereby the cylindrical bobbins of the former are pasted onto the adhesive sheet plane, an outfitting process whereby the terminals of the aforementioned closed magnetic path-type cylindrical coils are connected, via a fixation mechanism such as soldering, hot press, etc., to the upper plane electrode pattern of the aggregate insulation substrate, a resin feeding process whereby a resin-molding mold frame is configured around the aforementioned aggregate insulation substrate and whereby a sealing resin such as an epoxy resin, etc. is filled into & cured within the resulting gap, a peeling process whereby the adhesive sheet on the lower plane side of the aforementioned aggregate insulation substrate is peeled after the curing of the sealing resin, and a cutting process whereby the aggregate insulation substrate is divided into individual SMD-type coils by cutting, by using a dicing machine or slicing machine, the former not only along a cutting line passing through the virtual centers of the through-holes thereof but also along a cutting line perpendicular to the former cutting line in a state where a single closed magnetic path-type cylindrical coil is being enclosed in-between adjacent lines.

[0019]

Still another constitution of said coil is characterized by the fact that it consists of an aggregate insulation substrate work process whereby not only open units for storing the respective cylindrical bobbins of multiple closed magnetic path-type cylindrical coils but also multiple through-holes for connecting an upper plane electrode pattern are formed on the flat plane of the aforementioned aggregate insulation substrate, an electrode pattern formation process whereby an upper plane electrode pattern for the aforementioned aggregate insulation substrate and through-hole electrodes are formed, an adhesive sheet pasting process whereby an adhesive sheet on which are formed punch-through holes at positions corresponding to the respective through-holes formed on the aforementioned aggregate insulation substrate is pasted onto the rear plane side of the aforementioned aggregate insulation substrate in a state where the positions of the punch-through holes thereof are being matched with the aforementioned through-holes, a closed magnetic path-type cylindrical coil feeding process whereby closed magnetic path-type cylindrical coils are concurrently fed into and positioned within the open units formed on the aforementioned aggregate insulation substrate and whereby the cylindrical bobbins of the former are pasted onto the adhesive sheet plane, an outfitting process whereby the terminals of the aforementioned closed magnetic path-type cylindrical coils are connected, via a fixation mechanism such as soldering, hot press, etc., to the upper plane electrode pattern of the aggregate insulation substrate, a resin feeding process whereby a resin-molding mold frame is configured around the aforementioned aggregate insulation substrate and whereby a sealing resin such as an epoxy resin, etc. is filled into & cured within the resulting gap, and a cutting process whereby the aggregate insulation substrate is divided into individual SMD-type coils by cutting, by using a dicing machine or slicing machine, the former not only along a cutting line passing through the virtual centers of the through-holes thereof but also along a cutting line perpendicular to the former cutting line in a state where a single closed magnetic path-type cylindrical coil is being enclosed in-between adjacent lines without removing the adhesive sheet on the lower plane side thereof.

[0020]

Still another constitution of said coil is characterized by the fact that it consists of an aggregate insulation substrate work process whereby not only open units for storing the respective cylindrical bobbins of multiple closed magnetic path-type cylindrical coils but also multiple through-holes for connecting an upper plane electrode pattern are formed on the flat plane of the aforementioned aggregate insulation substrate, an electrode pattern formation process whereby an upper plane electrode pattern for the aforementioned aggregate insulation substrate and through-hole electrodes are formed, an adhesive sheet pasting process whereby an adhesive sheet the size of which is virtually equal to that of the aforementioned aggregate insulation substrate but which /6 possesses no punch-through holes corresponding to the aforementioned through-holes is pasted onto the rear plane side of the aforementioned aggregate insulation substrate, a closed magnetic path-type cylindrical coil feeding process whereby closed magnetic path-type cylindrical coils are concurrently fed into and positioned within the open units formed on the aforementioned aggregate insulation substrate and whereby the cylindrical bobbins of the former are pasted onto the adhesive sheet plane, an outfitting process whereby the terminals of the aforementioned closed magnetic path-type cylindrical coils are connected, via a fixation mechanism such as soldering, hot press, etc., to the upper plane electrode pattern of the aggregate insulation substrate, a resin feeding process whereby a resin-molding mold frame is configured around the aforementioned aggregate insulation substrate and whereby a sealing resin such as an epoxy resin, etc. is filled into the resulting gap, a resin curing process whereby a sheet-shaped component is contacted with & mounted on the upper plane of the cylindrical bobbins of the aforementioned closed magnetic path-type cylindrical coils within the aforementioned resin-molding mold frame for curing the filled sealing resin, a peeling process whereby the adhesive sheet on the lower plane side of the aforementioned aggregate insulation substrate is, after the curing of the sealing resin, peeled without peeling the adhesive sheet on the lower plane side of the aggregate insulation substrate, and a cutting process whereby the aggregate insulation substrate is divided into individual SMD-type coils by cutting, by using a

dicing machine or slicing machine, the former not only along a cutting line passing through the virtual centers of the through-holes thereof but also along a cutting line perpendicular to the former cutting line in a state where a single closed magnetic path-type cylindrical coil is being enclosed in-between adjacent lines.

[0021]

Still another constitution of said coil is characterized by the fact that it includes, after the aforementioned resin sealing process, a peeling process whereby both the aforementioned sheet-shaped component and adhesive sheet on the lower plane side of the aggregate insulation substrate are peeled and a cutting process whereby the aggregate insulation substrate is divided into individual SMD-type coils by cutting, by using a dicing machine or slicing machine, the former not only along a cutting line passing through the virtual centers of the through-holes thereof but also along a cutting line perpendicular to the former cutting line in a state where a single closed magnetic path-type cylindrical coil is being enclosed in-between adjacent lines.

[0022]

(Application embodiments of the invention)

In the following, the SMD-type coil of the present invention and method for manufacturing the same will be explained with reference to figures. Figure 1 ~ Figure 11 pertain to the SMD-type coil of the first application embodiment of the present invention as well as a method for manufacturing the same, where, of Figures 1, which show an individualized SMD-type coil, Figure 1 (a) is a plane view diagram, whereas Figure 1 (b) is a diagram which shows an A-A cross-sectional view of Figure 1 (a). Figure 2 is a diagram which shows an oblique view of an individually divided SMD-type coil. Figure 3 is a diagram which shows a cross-sectional view of a closed magnetic path-type cylindrical coil. Figure 4 is a partially magnified oblique view diagram which shows an aggregate insulation substrate work process and an electrode pattern formation process. Figure 5 is a partially magnified oblique view diagram of a hole-punched adhesive sheet.

Figure 6 is a partially magnified oblique view diagram which shows a pasting process for pasting an adhesive sheet onto an aggregate insulation substrate and a closed magnetic path-type cylindrical coil feeding process. Figure 7 is a partially magnified oblique view diagram which shows a soldering outfitting process. Figure 8 is a partially magnified oblique view diagram which shows a resin feeding process. Figure 9 is a partially magnified oblique view diagram which shows a resin sealing process. Figure 10 is a partially magnified oblique view diagram which shows a peeling process. Figure 11 is a partially magnified oblique view diagram which shows a dicing process. In these figures, components identical to their counterparts of the prior art are designated to bear identical notations.

[0023]

In Figures 1, (20) is an SMD-type coil. (21) is an insulation substrate made of a glass-epoxy resin, etc., whereas the open unit (21a) for storing the closed magnetic path-type cylindrical coil (5) discussed later is formed on this insulation substrate (21). The upper plane electrode pattern (22a), lower plane electrode pattern (22b), & side plane electrode pattern (22c), furthermore, are formed on the corresponding planes of the insulation substrate (21). The adhesive sheet (23) is pasted onto the lower plane of the aforementioned insulation substrate (21) in such a way that the open unit (21a) will be plugged. The closed magnetic path-type cylindrical coil (5) is positioned against the aforementioned open unit (21a), and the cylindrical bobbin (4) is pasted onto the adhesive sheet (23) plane. The coil initial & final terminal units (3b) & (3c) of the closed magnetic path-type cylindrical coil (5) are connected, via a fixation mechanism such as soldering, hot press, etc., to the electrode pattern formed above the insulation substrate (21).

[0024]

The sealing resin (17) such as an epoxy resin, etc. is filled & sealed not only onto the upper plane of the closed magnetic path-type cylindrical coil (5) with the exception of the upper plane electrode pattern (22a) of the aforementioned insulation substrate (21) but also into the connection interfaces of the terminals (3b) & (3c) and the open unit (21a).

[0025]

As Figure 3 indicates, as far as the constitution of the aforementioned closed magnetic path-type cylindrical coil (5) is concerned, (2) is a coil core made of a magnetic material such as Permalloy, etc., whereas the gate units (2a) & (2b) are formed on both ends of the former, whereas the slit (2c) for fixing coil terminals is formed on each of said gate units (2a) & (2b). (3) is a coil in possession of the coil unit (3a) provided by winding the coil (3) over a certain number of turns without wrapping said gate units (2a) & (2b). The coil initial terminal unit (3b) & coil final terminal unit (3c) of the coil unit (3a) are guided into and terminated with the aforementioned slits (2c) for constituting the core unit (1).

[0026]

(4) is a cylindrical bobbin made of a metallic magnetic material such as Permalloy, iron, etc. with a thickness of approximately 0.1 ~ 0.2 mm, for example. The aforementioned cylindrical bobbin (4) is a non-bottomless cylindrical case into which the aforementioned core unit (1) is inserted, and convexly drawn units (4a) & (4b) are formed on the inner diametric side of its cylindrical portion at positions corresponding to both gate units (2a) & (2b) of the aforementioned core unit (1) for establishing a contact. The inner diameters of the aforementioned drawn units (4a) & (4b) are designated for enabling the insertion, under pressure, & fixation of the gate units (2a) & (2b) of the core unit (1). The closed magnetic path-type cylindrical coil (5) is thus completed.

[0027]

The adhesive sheet (23) is designed to remain unremoved on the SMD-type coil (20) thus completed for purposes of preventing the short-circuit of a motherboard wire pattern and of facilitating, based on the color of the adhesive sheet (23), a sensor to recognize the front & rear sides of the finished product. Even if the aforementioned adhesive sheet (23) remains on the rear plane of the SMD-type coil (20), the adhesive sheet (23) is extremely thin, and therefore, [said coil] can be electrically connected easily to a motherboard wire pattern not shown in the figure such as a print substrate, etc. by means of soldering, etc. Since a closed magnetic path is constituted by the

cylindrical bobbin within the finished SMD-type coil (20), no noises are generated. Its size & thickness can, with regard equally to the thickness, width, & length thereof, accordingly be reduced in comparison with products known in the prior art.

[0028]

Next, a method for manufacturing the SMD-type coil of the aforementioned constitution will be explained with reference to Figure 4 ~ Figure 11. In Figure 4, (21A) is an aggregate insulation substrate made of a glass-epoxy resin, etc. to be divided into large numbers of individual units. The work process for the aggregate insulation substrate (21A) is executed by forming, at certain positions on the flat plane of the aggregate insulation substrate (21A), multiple columns of open units (21a) for storing the respective cylindrical bobbins (4) of multiple closed magnetic path-type cylindrical coils (5) and by forming, by using a processing mechanism such as an NC cutter, press, etc., multiple long through-holes (24) in-between the respective columns of the /7 aforementioned open units (21a). The aforementioned long through-holes (24) in-between columns are formed on the cutting line along the X direction, which will be discussed later.

[0029]

Next, an electrode pattern formation process is executed by washing the entire surface of the aggregate insulation substrate (21A), by then forming, by means of non-electrolytic plating, a copper plating layer on the entire surface, by applying a plating resist to be used for etching, and by forming, by means of exposure, via a pattern mask, & development, the upper plane electrode pattern (22a) & lower plane electrode pattern (22b) for the aggregate insulation substrate (21A) (Figure 1) as well as the through-hole electrodes (22c) (side plane electrode pattern shown in Figure 1) on the wall planes of the long through-holes (24) for mutually connecting both upper & lower plane electrode patterns (22a) & (22b). A nickel plating layer is formed, by means of electrolytic plating, on each of the electrode patterns thus formed, and after a gold plating layer has been formed above the former plating layer by means of electrolytic plating, a finished electrode pattern becomes obtained.

[0030]

In Figure 5, (23) is an adhesive sheet on which are formed multiple punch-through holes (23a) at positions corresponding to the respective long through-holes (24) formed on the aforementioned aggregate insulation substrate (21A).

[0031]

Incidentally, it goes without saying that there is no need to form long punch-through holes (23a) on the adhesive sheet (23) in the case of an SMD-type coil designed to become divided into individual units during a dicing process that follows the peeling of the adhesive sheet (23) pasted on the rear plane after a resin sealing process, which will be discussed below.

[0032]

In Figure 6, the adhesive sheet pasting process is executed by matching the respective positions of the long punch-through holes (23a) of the aforementioned adhesive sheet (23) and the long through-holes (24) of the aforementioned aggregate insulation substrate (21A) and by then pasting the adhesive sheet (23) onto the rear plane side of the aggregate insulation substrate (21A).

[0033]

Next, the closed magnetic path-type cylindrical coil feeding process is executed by concurrently feeding & positioning, into & within the open units (21a) formed on the aforementioned aggregate insulation substrate (21A), the cylindrical coils (5) by using an automatic mounting machine or by means of a manual operation and by pasting the cylindrical bobbins (4) onto the adhesive sheet (23) plane.

[0034]

In Figure 7, the mounting process is executed by connecting, by means of a fixation mechanism such as soldering with the solder (16) or hot press, etc., the terminals (3b) & (3c) of the closed magnetic path-type cylindrical coil (5) to the upper plane electrode pattern (22a) formed on the aforementioned aggregate insulation substrate (21A).

[0035]

In Figure 8, the resin feeding process is executed by configuring the resin molding mold frame (25) inside the confines of the long through-holes (24) of the aforementioned aggregate insulation substrate (21A) and by filling the sealing resin (17) (e.g., epoxy, etc.) into the resulting gaps with caution for avoiding the filling of the sealing resin (17) into the long through-holes (24). It goes without saying that the sealing resin (17) can also be dispensed into the outer gap of a tape enclosure instead of mounting the aforementioned resin molding mold frame (25). Incidentally, in a case where a sheet-shaped component discussed later is mounted on the upper plane of the cylindrical bobbin (4) of the aforementioned cylindrical coil (5) and where the former is surrounded & enclosed by a tape, a resin dispensing gate is configured on a portion of the tape for dispensing the sealing resin (17).

[0036]

In Figure 9, the resin sealing process is executed by mounting & contacting the sheet-shaped component (26) on & with the upper plane of the cylindrical bobbin (4) of the aforementioned closed magnetic path-type cylindrical coil (5) within the aforementioned resin molding mold frame (25) and by curing the filled sealing resin. The aforementioned sheet-shaped component (26) is mounted for the purpose of homogenizing the surface of the filled internal resin. The quantitative ratio of the aforementioned sealing resin (17) is selected in such a way that a portion of the cylindrical bobbin (4) of the closed magnetic path-type cylindrical coil (5) will be even with or slightly protrude from the resin plane.

[0037]

In Figure 10, the peeling process is executed, after the curing of the sealing resin (17), by peeling the aforementioned sheet-shaped component (26) and removing the aforementioned resin molding mold frame (25) without removing the adhesive sheet (23) on the lower plane side of the aggregate insulation substrate (21A), as a result of which the SMD-type coil (20A) becomes formed.

[0038]

In Figure 11, the dicing process is executed by cutting, by using a dicing machine or slicing machine, the aggregate insulation substrate (21A) not only along the X direction cutting line (27), which passes through the virtual centers of the long through-holes (24), but also along the Y direction cutting line (28), which is perpendicular to the former, in a state where a single closed magnetic path-type cylindrical coil (5) is being enclosed in-between adjacent lines for the purpose of dividing said substrate into individual SMD-type coils (20).

[0039]

In the above-mentioned Figure 2, the adhesive sheet (23) is designed to remain unremoved on the SMD-type coil (20) thus divided for purposes of preventing, in a case where [said coil is] outfitted on a motherboard, the short-circuit of a motherboard wire pattern and of facilitating, based on the color of the adhesive sheet (23), a sensor to recognize the front & rear sides of the finished product. Since the closed magnetic path-type cylindrical coil (5) is positioned by the adhesive sheet (23) according to this manufacturing method, the former can be outfitted by using a general & common mounter, and no special device is required. The position[al precision?] of the cylindrical coil (5) is determined by the precision of the mounter and is, unlike its traditional counterparts, unaffected by the precision of a guide hole.

[0040]

As far as the SMD-type coil of the second application embodiment the present invention is concerned, the sheet-shaped component mounted, as has been mentioned earlier, on the internal sealing resin filled into the resin molding mold frame for the purpose of homogenizing the surface of said resin is designed to remain as it is rather than being peeled. In other words, a product in possession of both a sheet-shaped component and an adhesive sheet is hereby provided. Such a constitution is advantageous from standpoints not only of preventing short circuiting but also of ensuring mounting in a case where another electronic component is configured in high proximity above the SMD-type coil.

[0041]

The constitution of the SMD-type coil of the third application embodiment of the present invention is equivalent to that of the SMD-type coil explained with regard to the above-mentioned second application embodiment except that the sheet-shaped component on the upper plane is designed to remain unremoved and that the adhesive sheet on the rear plane side is peeled, based on which the thickness can be reduced.

[0042]

The constitution of the SMD-type coil of the fourth application embodiment of the present invention is identical to that of the SMD-type coil explained with regard to the above-mentioned first application embodiment except that the adhesive sheet on the rear plane side is peeled (i.e., a product from which both a sheet-shaped component and an adhesive sheet have been removed), based on which the thickness can be further reduced. /8

[0043]

As far as the aforementioned SMD-type coils are concerned, the sheet-shaped components are peeled after the resin sealing process, although it goes without saying that the process for peeling a sheet-shaped component becomes unnecessary in a case where the resin sealing process is executed without using the aforementioned sheet-shaped component.

[0044]

As the structure of a product the weight, thickness, & size of which have been further reduced in comparison with the above-mentioned SMD-type coils of the present invention, an SMD-type coil with a simplified electrode pattern provided by forming through-holes on four corners of a substrate will be explained with reference to Figure 12 & Figure 17.

[0045]

Figure 12 (a) is a plane view diagram pertaining to the SMD-type coil of the fifth application embodiment of the present invention, whereas Figure 12 (b) is a diagram which shows a cross-sectional view of the B-B line in Figure 12 (a), whereas Figure 17 is a diagram which shows an oblique view of Figure 12. In these figures, (30) is an SMD-type coil, whereas (31) is a first

minor insulating substrate with a virtually rectangular shape made of a glass-epoxy resin, etc. The upper plane electrode patterns (31a) & (31b) and through-hole electrodes (31a) & (31b) connected respectively to said upper plane electrode patterns (31a) & (31b) are formed on the upper plane of said first minor insulating substrate (31). (32) is a second minor insulating substrate made of a glass-epoxy resin, etc. with a shape virtually identical to that of the aforementioned first minor insulating substrate (31). The through-hole electrodes (32c) & (32d) are formed on said second minor insulating substrate (32). (33) is an adhesive sheet. The aforementioned pair of minor insulating substrates (31) & (32) are configured in opposition to one another above the adhesive sheet (33) in such a way that their respective through-hole electrodes will face outward, and the open unit (34) for storing the cylindrical bobbin (4) of the cylindrical coil (5) is thus constituted.

[0046]

The cylindrical coil (5) is positioned against and then fixed to the aforementioned open unit (34) by pasting the cylindrical bobbin (4) onto the adhesive sheet (33) plane. The terminals (3b) & (3c) of the cylindrical coil (5) are connected respectively to the upper plane electrode patterns (31a) & (31b) formed above the aforementioned first minor insulating substrate (31) via a fixation mechanism such as soldering, hot press, etc.

[0047]

The upper plane of the closed magnetic path-type cylindrical coil (5), connection interface of the coil terminals (3b) & (3c), and the respective upper planes of the open unit (34) & through-holes are, with the exception of the through-hole electrodes (31c), (31d), (32c), & (32d) of the aforementioned pair of minor insulating substrates (31) & (32), filled & sealed with the sealing resin (17) such as an epoxy resin, etc. The through-hole upper planes are preliminarily masked with a mask component not shown in the figure for the purpose of preventing the sealing resin (17) from being filled into the aforementioned through-hole electrodes (31c), (31d), (32c), & (32d). The space above the mask becomes filled with the sealing resin (17).

[0048]

The SMD-type coil (30) thus completed possesses no adhesive sheet (33) on the through-hole electrodes (31c), (31d), (32c), & (32d) at four positions, but since the adhesive sheet (33) is extremely thin, [said coil] can be electrically connected easily to the wire pattern of a motherboard not shown in the figure such as a print substrate, etc. The adhesive sheet (33) is designed to remain unremoved from the lower plane of the SMD-type coil (30) for purposes of preventing the short-circuit of a motherboard wire pattern and of facilitating, based on the color of the adhesive sheet (23), a sensor to recognize the front & rear sides of the finished product, as has been mentioned earlier. The size & thickness of the completed SMD-type coil (30) can therefore be reduced more effectively.

[0049]

Next, a method for manufacturing the SMD-type coil characterized by the aforementioned constitution will be explained with reference to Figure 13 ~ Figure 16. In Figure 13, (40) is an aggregate insulating substrate made of a glass-epoxy resin, etc. to be divided into large numbers of individual units. The work process for this aggregate insulating substrate (40) is similar to that of the above-mentioned first application embodiment, according to which multiple columns of open units (34) for storing the respective cylindrical bobbins (4) of multiple closed magnetic path-type cylindrical coils (5) are formed at certain positions on the flat plane of the aggregate insulation substrate (40), and multiple through-holes (40a) are formed in-between the respective columns of the aforementioned open units (34) by using a processing mechanism such as an NC cutter, press, etc.

[0050]

Next, the electrode pattern formation process is a process whereby the upper plane electrode pattern (40b) and through-hole electrodes (40c) are formed on the aforementioned aggregate insulating substrate (40), and since it is similar to its counterpart of the above-mentioned first application embodiment, no overlapping explanations will be provided.

[0051]

In Figure 14, (33) is an adhesive sheet on which are formed multiple punch-through holes (33a) at positions corresponding to the through-holes (40a) formed on the aggregate insulating substrate (40).

[0052]

Incidentally, there is no need to form punch-through holes (33a) on the adhesive sheet (33) in the case of an SMD-type coil type to be divided into individual units during a dicing process upon the peeling, after the resin sealing process, of the adhesive sheet (33) pasted onto the rear plane thereof.

[0053]

In Figure 15, the adhesive sheet pasting process is executed by matching the respective positions of the punch-through holes (33a) of the aforementioned adhesive sheet (33) and the through-holes (40a) of the aforementioned aggregate insulating substrate (40) and then by pasting the adhesive sheet (33) onto the rear plane of the aggregate insulating substrate (40).

[0054]

Next, the closed magnetic path-type cylindrical coil feeding process and outfitting process shown in Figure 16 are similar to their counterparts of the aforementioned first application embodiment, and therefore, no overlapping explanations will be provided.

[0055]

Next, the resin feeding process is similar to its counterpart of the above-mentioned first application embodiment except that the aforementioned through-holes (40a) are masked with a mask component in advance for preventing the filling of the sealing resin (17) into the interior of the former.

[0056]

The resin sealing process and dicing process are similar to their counterparts of the aforementioned first application embodiment, and therefore, no overlapping explanations will be provided.

[0057]

As has been instantiated by the aforementioned fifth application embodiment, it is conceivable to provide, as the individualized SMD-type coil (30), a product of a type whereby a sheet-shaped component above a cylindrical bobbin is peeled without removing an adhesive sheet on the lower plane of a substrate, a product wherein both an adhesive sheet and a sheet-shaped component remain unremoved, a product wherein an adhesive sheet is peeled without removing a sheet-shaped component, and/or a product wherein both an adhesive sheet and a sheet-shaped component are removed, as can be gleaned from the explanations of the above-mentioned first through fourth application embodiments.

[0058]

(Effects of the invention)

As the foregoing explanations have demonstrated, the present invention provides a method wherein storage units for multiple closed magnetic path-type cylindrical coils are formed above an aggregate insulation substrate to be divided into multiple individual units, wherein an adhesive sheet is pasted, and wherein a cylindrical bobbin is positioned above & fixed to said adhesive sheet, according to which a mounting operation can be executed by using a general & common mounter without recourse to a special device, and therefore, [the obtained product is], unlike its counterparts of the prior art, unaffected by the guide hole precision. Size & thickness reduction effects can therefore be achieved with regard to thickness, width, & length dimensions alike in comparison with products of the prior art, and accordingly, it qualifies as an electronic component designed to /9 achieve size, weight, & thickness reduction effects. Various finished products can, furthermore, be provided depending on the combinations of sheet-shaped components and adhesive sheets. In a case where a noise measure is orchestrated by mounting a closed magnetic path-type cylindrical coil, in particular, it becomes possible to upgrade the reliability and to provide an inexpensive SMD-type coil with a favorable productivity as well as a method for manufacturing the same.

Brief explanation of the figures

Figures 1: They pertain to the SMD-type coil of the first application embodiment of the present invention, where Figure 1 (a) is a plane view diagram of the SMD-type coil, whereas Figure 1 (b) is a diagram which shows a cross-sectional view of the A-A line in Figure 1 (a).

Figure 2: An oblique view diagram of the SMD-type coil of Figure 1.

Figure 3: A cross-sectional view diagram of the mounted closed magnetic path-type cylindrical coil in Figure 1.

Figure 4: A partially magnified oblique view diagram which shows an aggregate insulation substrate work process and an electrode pattern formation process with regard to the method for manufacturing the SMD-type coil of the first application embodiment of the present invention.

Figure 5: A partially magnified oblique view diagram which shows a hole-punched adhesive sheet with regard to the method for manufacturing the SMD-type coil of the first application embodiment of the present invention.

Figure 6: A partially magnified oblique view diagram which shows a process for pasting the adhesive sheet of Figure 5 onto the aggregate insulation substrate of Figure 4 and a closed magnetic path-type cylindrical coil feeding process.

Figure 7: A partially magnified oblique view diagram which shows an outfitting process whereby connection is established in Figure 6 by means of a fixation mechanism such as soldering, hot press, etc.

Figure 8: A partially magnified oblique view diagram which shows a resin feeding process executed upon the mounting of a resin molding mold frame in Figure 7.

Figure 9: A partially magnified oblique view diagram which shows a resin sealing process executed upon the mounting of the resin molding mold frame in Figure 8.

Figure 10: A partially magnified oblique view diagram which shows a sheet-shaped component peeling process executed upon the removal of the resin molding mold frame in Figure 9.

Figure 11: A partially magnified oblique view diagram which shows the dicing process in Figure 10.

Figures 12: They pertain to the SMD-type coil of the fifth application embodiment of the present invention, where Figure 12 (a) is a plane view diagram of the SMD-type coil, whereas Figure 12 (b) is a diagram which shows a cross-sectional view of the B-B line in Figure 12 (a).

Figure 13: A partially magnified oblique view diagram which shows an aggregate insulation substrate work process and an electrode pattern formation process with regard to the method for manufacturing the SMD-type coil of the fifth application embodiment of the present invention.

Figure 14: A partially magnified oblique view diagram which shows a hole-punched adhesive sheet with regard to the method for manufacturing the SMD-type coil of the fifth application embodiment of the present invention.

Figure 15: A partially magnified oblique view diagram which shows a process whereby the adhesive sheet of Figure 14 is pasted onto the aggregate insulation substrate of Figure 13 and a closed magnetic path-type cylindrical coil feeding process with regard to the method for manufacturing the SMD-type coil of the fifth application embodiment of the present invention.

Figure 16: A partially magnified oblique view diagram which shows an outfitting process whereby connection is established in Figure 15 by means of a fixation mechanism such as soldering, hot press, etc.

Figure 17: An oblique view diagram of the SMD-type coil of Figure 12.

Figure 17: An oblique view diagram of a chip coil known in the prior art.

(Explanation of notations)

(1): Core unit;

(2): Coil core;

(3): Coil;

(3b): Initial coil terminal;

(3c): Final coil terminal;

(4): Cylindrical bobbin;

(5): Closed magnetic path-type cylindrical coil;

(16): Solder;

(17): Sealing resin;

(20) & (30): SMD-type coils;

(20A): SMD-type coil aggregate;

(21): Insulation substrate;

(21A) & (40): Aggregate insulation substrates;

(21a) & (34): Open units;

(22a), (31a), & (31b): Upper plane electrode patterns;

(22c): Side plane electrode pattern;

(23) & (33): Adhesive sheets;

(24): Long through-hole;

(25): Resin molding mold frame;

(26): Sheet-shaped component;

(27): X direction cutting line;

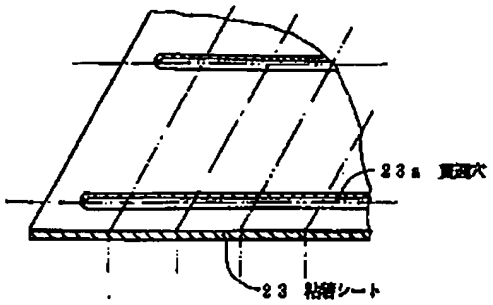
(28): Y direction cutting line;

(31): First minor insulating substrate;

(32): Second minor insulating substrate;

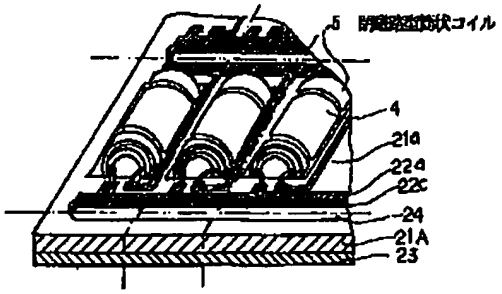
(31c), (31d), (32c), & (32d): Through-hole electrodes.

Figure 5



[(23): Adhesive sheet; (23a): Punch-through hole]

Figure 6

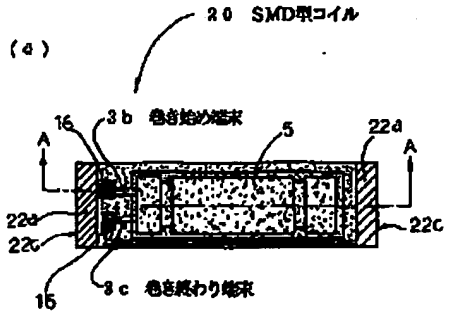


[(5): Closed magnetic path-type cylindrical coil]

Figures 1

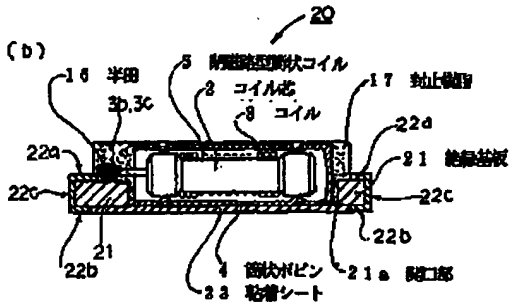
/10

(a)



[(3b): Initial coil terminal; (3c): Final coil terminal; (20): SMD-type coil]

(b)



[(2): Coil core; (3): Coil; (4): Cylindrical bobbin; (5): Closed magnetic path-type cylindrical coil; (16): Solder; (17): Sealing resin; (21): Insulation substrate; (21a): Open unit]

Figure 2

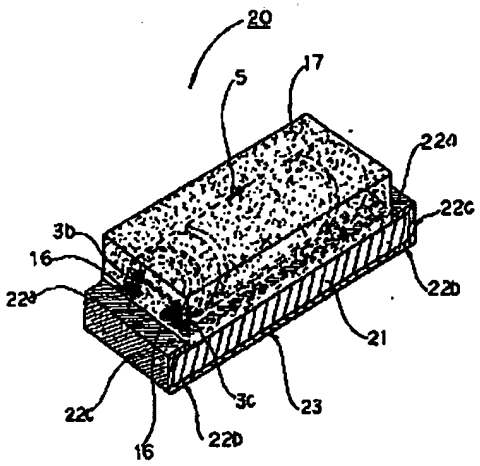
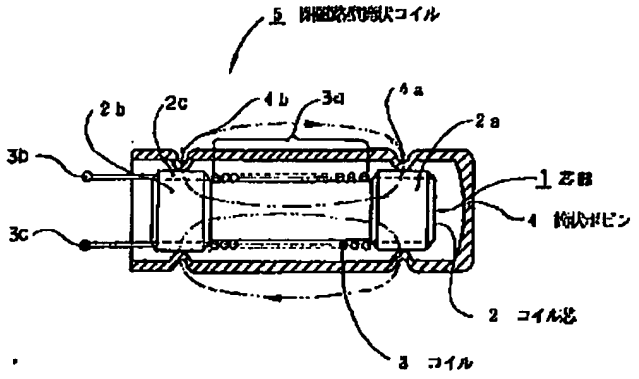
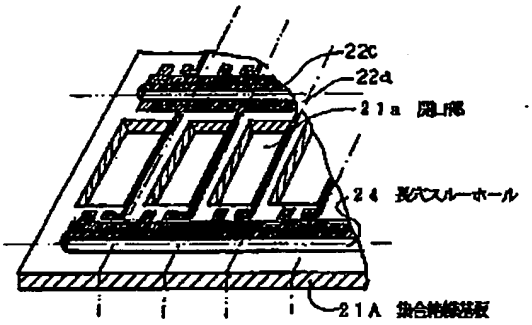


Figure 3



[(1): Core unit; (2): Coil core; (3): Coil; (4): Cylindrical bobbin; (5): Closed magnetic path-type cylindrical coil]

Figure 4



[(21A): Aggregate insulation substrate; (21a): Open unit; (24): Long through-hole]

Figure 7

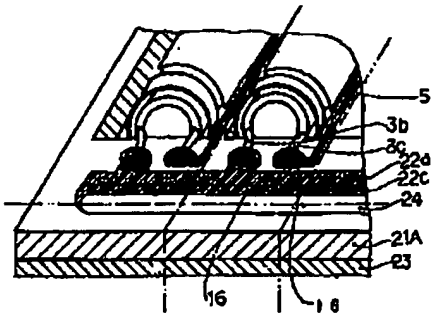
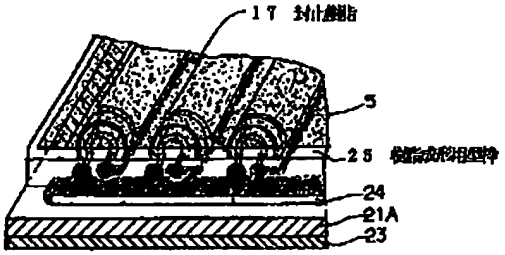
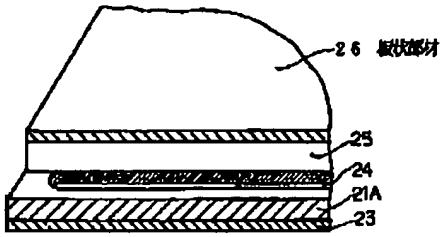


Figure 8



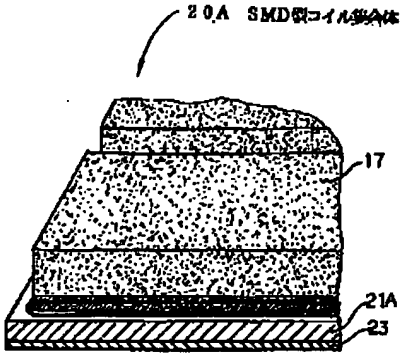
[(17): Sealing resin; (25): Resin molding mold frame]

Figure 9



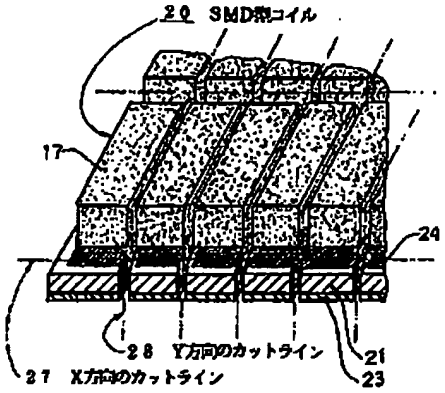
[(26): Sheet-shaped component]

Figure 10



[(21A): Aggregate insulation substrate]

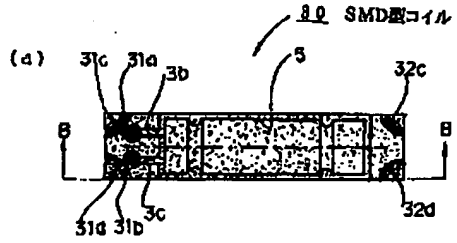
Figure 11



[(20): SMD-type coil; (27): X direction cutting line; (28): Y direction cutting line]

Figures 12

(a)



[(30): SMD-type coil]

(b)

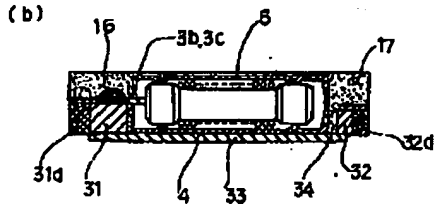
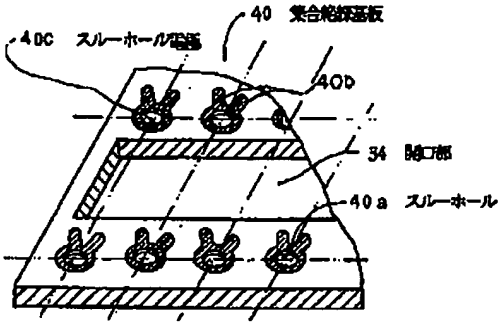
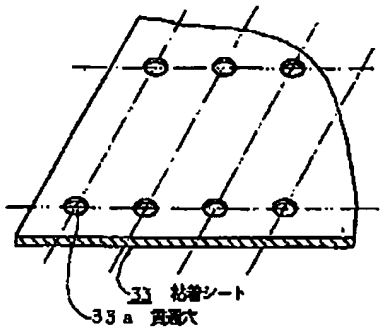


Figure 13



[(34): Open unit; (40): Aggregate insulation substrate; (40a): Through-hole; (40c): Through-hole electrode]

Figure 14



[(33): Adhesive sheet; (33a): Punch-through holes]

Figure 15 /12

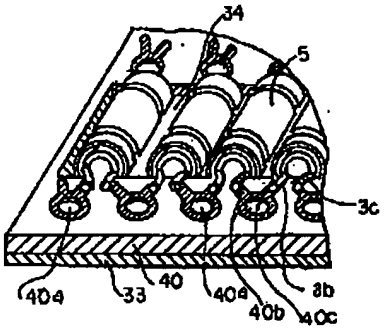


Figure 16

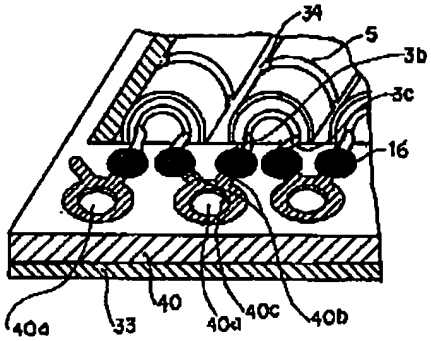


Figure 17

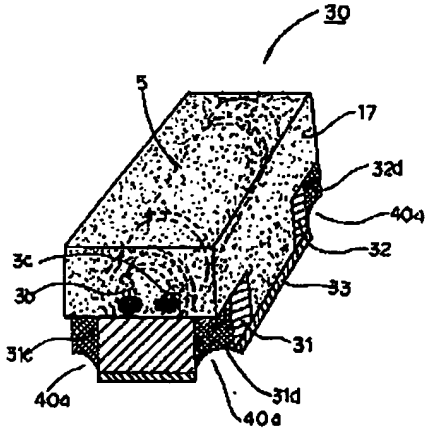


Figure 18